

## Use of High-Concentrate or High Forage Diets for Transition Dairy Cows

Ric R. Grummer  
 Professor Emeritus  
 Department of Dairy Science  
 University of Wisconsin-Madison

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Objective of today's presentation: a historical review of research on feeding energy to transition cows

- "Steaming up" close-up transition cows
- Controlled energy diets (Goldilocks, one diet for entire dry period)
- Postfresh transition cows (HOT, starch)

## Origin of the Concept of Steaming Up Close-Up Transition Cows

Robert Bouffleur at the World Dairy Congress (1928) first proposed the "steam up" ration as a way to circumvent "the neglect of the preparation of the cows for her lactation period". The term was meant to be an analogy to the preparation of a steam thresher.

## "Steaming Up": Feeding Additional Grain During Final Weeks Prepartum?

- Adapt Microflora
- Grow Papillae
- More Energy
  - DMI
  - Energy Density
- Decrease Fat Mobilization

## Conventional Dry Cow Feeding Strategy:

- Far-off dry cow
  - Low energy diet to maintain body condition score
  - $NE_l = .63 - .68$  Mcal/kg
  - Low quality forages acceptable
- Close-up dry cow diet
  - Increase grain feeding
  - $NE_l = .70 - .72$  Mcal/kg

## Pre-fresh NFC??

Trial	NFC, % DM
Minor et al., 1998	35
	44
Mashek and Beede, 2000	35
	38
Keady et al., 2001	13
	28
Holcomb et al., 2001	25
	24
Doepel et al., 2001	30
	38
Rabelo et al., 2003, 05	45
	38
Smith et al., 2005	34
	40
Kamiya et al., 2006	28
	33
Guo et al., 2007	26
	39
Roche et al., 2010	13
	32
Zhang et al., 2015	21
	27
	34
Vickers et al., 2014	27
	33
Zhang et al., 2015	21
	27
	34

### Summary of Results

- 8/10 Studies showed a significant increase in prepartum DMI.
- 0/9 Studies showed any significant effect on postpartum DMI.
- 0/11 Studies showed any significant effect on milk yield.
- 1/5 Studies showed a significant reduction in liver fat.
- Health and reproduction?????

### Why After ~100 Years, We No longer Need to “Steam-up” Cows??

- TMR (elimination of slug feeding grain)
- Low feed intakes near the time of calving
- Gradual increases in concentrate consumption postpartum as TMR dry matter intake increases
- Exceptions??:
  - High straw (controlled energy) diets
  - Concentrate fed separate from forage
  - Situations in which energy requirements are not met (low feed intakes):
    - Poor facilities, heat stress, etc.



Message conveyed to the industry: You can feed one dry cow diet that contains high (poor quality) forage-low concentrate

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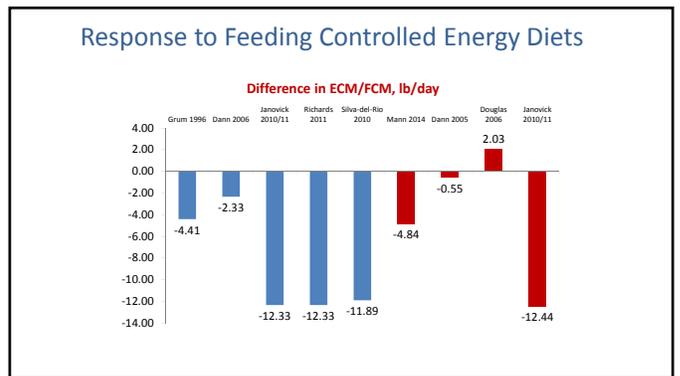
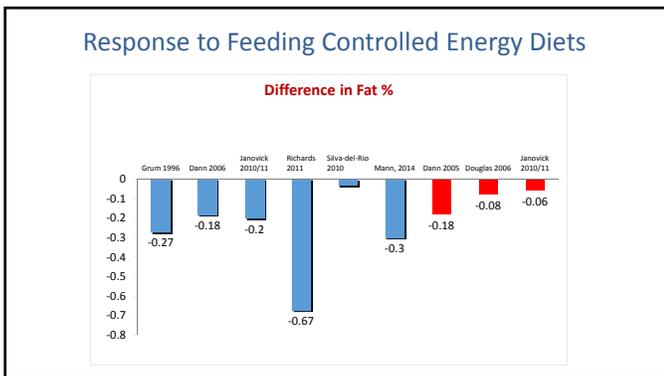
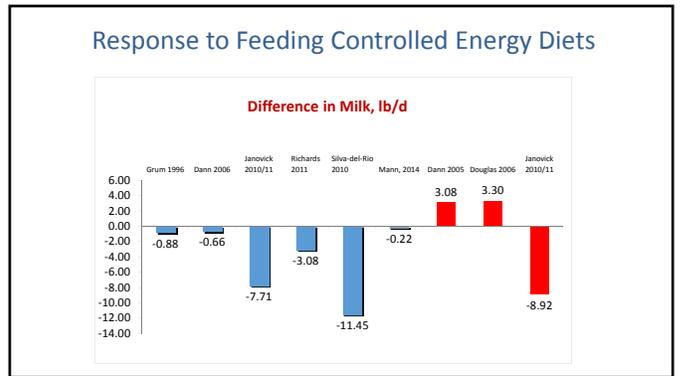
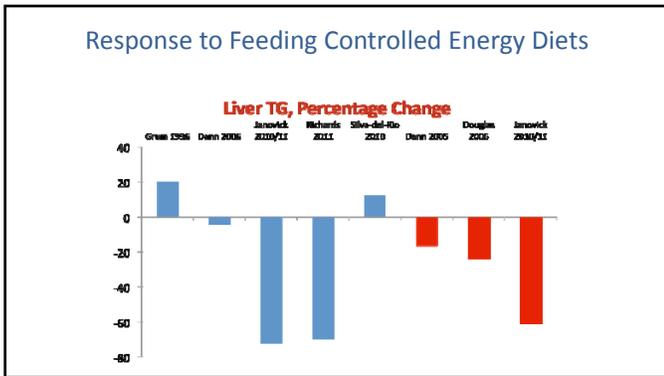
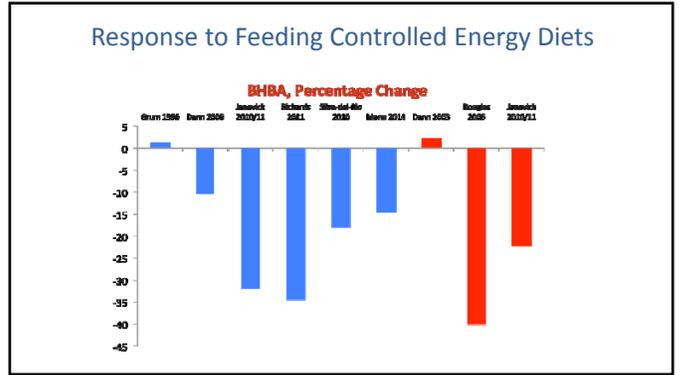
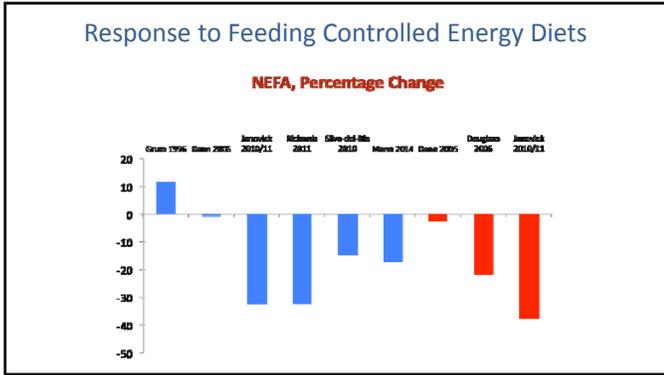
- “Steaming” up close-up transition cows
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### “Controlled” Energy Dry Cow Diets

- High in poor quality forage, typically straw
- Cows are less insulin resistant
  - Lower rates of lipolysis
  - Less fatty liver
  - Lower BHBA (less ketosis)
- Greater DMI postpartum (?)
- Fewer displaced abomasums
- Only need one diet for the dry period (?)

### Two Experimental Approaches to Controlling Energy Intake of Dry Cows

- Ad libitum feed intake of a diet with very low energy density
  - Practical, can apply in the real world
  - Experimental treatments: Control “moderate” energy density diet vs low energy density diet, both fed ad libitum
  - Typically 150 vs 100% of cows energy requirement
  - Blue bars
- Restricted feed intake of a “moderate” energy density diet
  - Not practical in the real world
  - Experimental treatments: Control (ad libitum) vs restricted feed intake of “moderate” energy density diet
  - Typically 150 vs 80% of cows energy requirement
  - Red bars



### This Data Makes Total Sense!!!!

- Cows fed controlled energy diets mobilize less fat (NEFA)
- NEFA are used by the mammary gland
  - Energy source
  - Precursor for milk fat synthesis
- If you reduce NEFA availability to the mammary gland, it should not be surprising that there may be downstream effects on lactation performance
- The goal is to have a balancing act: provide sufficient NEFA to the mammary gland to support lactation without the cow experiencing negative effects that may result if NEFA mobilization is excessive.

### Hmmmmmmmm.....

“Nutritional restriction to adipose tissue mobilisation might be necessary, but there is a philosophical problem. We have selected cows that have increased reliance on mobilised body reserves as a source of nutrients for milk production. The farmer has paid the geneticist for this- are we now going to ask him to pay the nutritionist to work in the opposite direction? We have our priorities wrong. We should explore what can be done to help the liver deal with mobilised fatty acids before considering whether we need to try to reduce the amount of fatty acid supplied to the liver.”

J. R. Newbold. 2005. Liver Function in Dairy Cows. Recent Advances in Animal Nutrition

### Conclusions/Questions- Controlled Energy Diets

- Feeding one diet for the entire dry period that does not exceed energy requirements will result in less fat mobilization and lower plasma NEFA, BHBA, and liver fat.
- Milk fat percentage is likely to be reduced and in a few trials milk yield has also been reduced.
- Optimum level of energy density has not been determined
- “Gut” feeling is that feeding to 100% (or less) of energy requirements may be too low to optimize postpartum lactation performance.

### Conclusions/Questions- Controlled Energy Diets

- Do we still need a separate “close-up” diet for supplements?
  - Anionic salts
  - Yeast
  - Protected choline
- When feeding high straw (or other low quality forage quality), can cows benefit from “steaming up”
  - Pre or postfresh?

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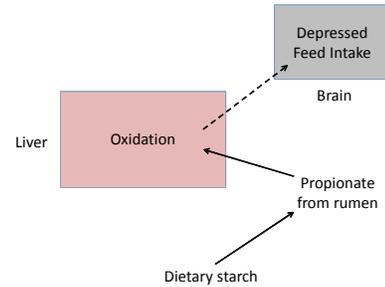
### Lots of Questions Regarding Postfresh Energy!!

- Do you put cows right onto high group diet?
- Should you feed straw/low quality forage right after calving? Baled hay?
- Do we try and get cows to increase milk production as fast as possible or do we try and hold them back??
  - Does starting cows out on high group TMR push cows “too hard”: DA, acidosis, severe negative energy balance, fatty liver, ketosis, poor reproductive performance
  - Or, does restricting energy intake exacerbate negative energy balance.....
- Starch levels????
- Amazingly, little research is available.

### Starch Level and Energy Intake

- Potential benefits of increasing starch in postfresh diets
  - Increased energy density of diet
  - Greater energy intake
  - Greater milk yield
  - Less fat mobilization, metabolic disorders
- Negative effects
  - Displaced abomasum, acidosis
  - Some suggest increasing starch or fermentability of starch during the first few weeks postpartum reduces feed intake

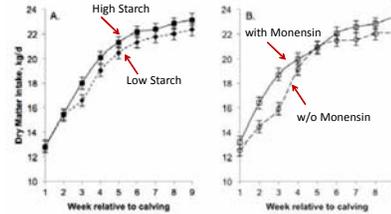
### “Hepatic Oxidation Theory: HOT”



### Starch Level/Monensin (McCarthy et al., 2013)

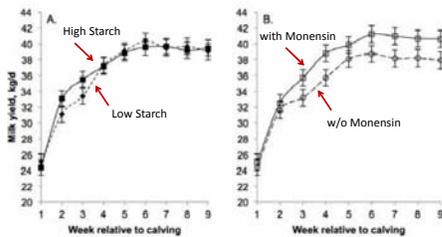
- 2 x 2 factorial
- 21.5 vs 26.2% starch weeks 1-3 postpartum
- With or without monensin (400 mg/d 3 wk pre to calving, 450 mg/d from d 0 to d 63 post)

### Dry Matter Intake



McCarthy et al., 2013

### Milk Yield



McCarthy et al., 2013

### Starch Level??

Nelson et al, (2011)

- Hypothesis: Cows coming off a low energy dry cow diet may benefit from lower starch diets post-calving
- Treatments: Corn out, soybean hulls & wheat midds in

	Low	Medium	High
NDF, %	35.7	33.9	31.9
Starch, %	21.0	23.2	25.5
Rumen ferm. starch, %	16.8	18.9	20.2
Day 1-21	L	M	H
Day 22-91	L	H	H

### Starch Level??

Nelson et al. (2011)

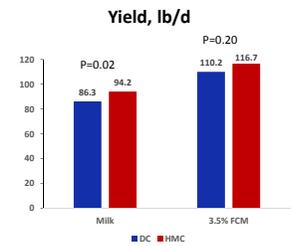
	L	M	H
DMI, kg/d	25.2 <sup>x</sup>	24.9 <sup>xy</sup>	23.7 <sup>y</sup>
Milk, kg/d	47.9 <sup>ab</sup>	49.9 <sup>a</sup>	44.2 <sup>b</sup>
Fat%	3.88 <sup>x</sup>	3.64 <sup>y</sup>	3.79 <sup>xy</sup>
NEFA, uEq/L	452 <sup>y</sup>	577 <sup>x</sup>	431 <sup>y</sup>

a,b (P<0.05)  
x,y (P<0.10)

### Corn Processing/Starch Fermentability??

Rockwell and Allen, 2016

- Design:
  - Dry Corn vs HMC
  - 26.5% starch
  - 0 to 28 DIM
  - Common diet from d28 to 84
  - n= 24 per treatment
- Results
  - No differences in DMI for first 28 days postpartum



### Starch x Fermentable Starch

(Albornoz and Allen, JAM Abstr. 355, 2016)

- 2 x 2 Factorial arrangement of treatments
  - 22 vs 28% starch (corn replaced soy hulls)
  - High moisture corn (HMC) vs dry ground corn (DGC)
- 22% forage NDF, 17% CP
- Treatments d 1-23 postpartum, carry over d 24-72 (common 30% starch diet)
- DGC increased DMI 2.2 kg/d vs HMC during treatment period and effect diminished during carry over period
- Starch level did not affect DMI

### Conclusions: Postfresh Starch

- Why contradictory results?
  - Dependent on prefresh starch?
  - Dependent on level/fermentability of starch?
  - Dependent on other carbohydrate sources?
  - Dependent on NDF and it's digestibility?
- More research to define optimal levels

### Conclusions

- In most situations, cows do not need to be fed a separate close-up diet for the purpose of increasing concentrate (starch) intake.
- Feeding controlled energy diets reduces fat mobilization, blood NEFA and BHBA, and liver TG.
- When feeding controlled energy diets, milk fat percentage is likely to be reduced and in a few trials milk yield has also been reduced.
- Optimum energy density for single dry cow diets has not been defined.
- Fresh cows *should* be able to be fed diets containing 25-26% starch immediately after calving. But further research is needed to determine how factors such as prefresh diet, starch fermentability, fiber digestibility, etc. may influence the optimum starch content of fresh cow diets.
- Formulating transition cow diets is part SCIENCE and part ART